IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Kie Y. Ahn et al.	Examiner: Colleen Rodgers
Serial No.:	09/945,535	Group Art Unit: 2813
Filed:	August 30, 2001	Docket: 1303.026US1
Title:	HIGHLY RELIABLE AMORPHOUS HIGH-K GATE OXIDE ZrO2	

PRE-APPEAL BRIEF REQUEST FOR REVIEW

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

The applicant requests review of the final rejection in the above-identified application. No amendments are being filed with this request.

This request is being filed with a Notice of Appeal.

The review is requested for the reason(s) stated below:

Applicant respectfully disagrees with the Examiner's characterization of the teachings of the cited references. Applicant submits that Ma clearly suggests a heavily doped metal layer, oxidized to form transistor gate dielectric. Ma teaches a high dielectric constant film "that remains amorphous at relatively high annealing temperatures" by use of "either Zr or Hf, doped with a trivalent metal, such as Al" which clearly and strongly states that the use of pure metals is a problem to be solved by the use of heavy doping with a trivalent metal. This is found in the cited reference of Ma in the abstract and in virtual every single paragraph and every independent claim. See for example col. 1, lines 35, 41, 53, 60, 61, 64; col. 2, lines 2, 21, 24, 27, 29, 37, 39, 43, 49, 61, 68; col. 3, lines 3, 13, 34, 36, 45, 50, 61, 63; col. 4, lines 1, 5, 14, 20, 21, 28, 29, 46, 57, 64; col. 5, lines 44, 53, 62, 65 (listing the range of 0-50%); col. 6, lines 21, 23, 26, 34, 42, 46, 51, 60; col. 7, lines 6, 9, 11, 17, 21, 22, 31, 47, 65; col. 8, lines 20, 25, 27, 31, 37, 56, 61, 67; col. 9, lines 6, 8, 13, 17; and col. 10, line 18. This repeated statement of Ma proves that the Examiner is incorrect to suggest that Ma discloses "a substantially pure single metal layer".

The Examiner incorrectly points to Ma at col. 2, lines 65-67; col. 3, lines 53-55 and 60-62; and col. 5, lines 65-66" for the suggestion of pure metal. However, the cited sections are taken out of context and mischaracterize Ma. The Examiner cited section of col. 2, lines 65-67 recites that "a metal selected from the group consisting of zirconium (Zr) and hafnium (Hf), and oxygen", is actually the second half of a sentence clearly teaching that a "film including a

trivalent metal, such as aluminum (Al), scandium (Sc), or lanthanum (La), ..." and then concluding with the incomplete portion cited by the Examiner to incorrectly indicate only a pure metal is taught.

The Examiner incorrectly cites col. 3, lines 53-55, to support the erroneous contention that Ma suggests a single pure metal. The cited section actually states "In short, it was discovered that ***doping*** a ZrO2 film, with a trivalent metal such as Al, results in that film remaining amorphous under typical (high temperature) processing conditions" (emphasis added). Again, this clearly teaches a non-pure metal and specifically states that it is teaching doping of metal.

The Examiner points to col. 3, lines 60-62 to prove that the metal is pure. Applicant submits that the cited section should include the preceding sentence. The cited section states "The present invention is a thin film having a high dielectric constant, with respect to silicon dioxide, which comprises a trivalent metal, a metals selected from the group consisting of zirconium (Zr) and hafnium (Hf), and oxygen. The high dielectric film is resistant to crystallization, remaining amorphous for form a smoother surface. The trivalent metal is selected form the group consisting of aluminum (Al), scandium (Sc), and lanthanum (La)". Ma strongly suggests an alloy and not a pure metal of any sort, in contradiction to the Examiner's suggestion.

The Examiner cites col. 5, lines 65-66" as proof of the suggestion of pure metal in Ma. The cited section states "The percentage of Al, or other trivalent metal, in film 56 is in the range of approximately 0 to 50%", which is stated by the Examiner to suggest that the lower end of the range of 0% is suggested by Ma. Applicant disagrees and notes that the next sentence in this paragraph states "Preferably, the percentage of Al in film 56 is approximately 25%". This preferred range in conjunction with the use of the term alloy and trivalent metal in virtually every preceding paragraph clearly teaches away from pure metal, as do the figures which show the improvement to be found by use of 25% alloys of trivalent metal. Applicant submits that no one of ordinary skill in the art could possibly be motivated to use a pure metal (i.e., 0% alloy) by reading this reference which strongly teaches away from the use of pure metals.

The reference fairly teaches deposition of Zr or Hf doped with up to 50% of a trivalent metal such as aluminum. Ma states that 25% doping is the preferred level. This teaching of the importance of the use of extremely impure metal is repeated throughout the cited reference which

teaches that the doping with trivalent materials causes the film to "resist the formation of a crystalline structure, interfaces to adjacent films have fewer irregularities", and "the film can be made thin to support smaller transistor geometries, while the surface of the channel region can be made smooth to support high electron mobility". The figures show the properties, such as IV characteristics, leakage currents, time dependent dielectric breakdown voltages, and time to failure plots, of trivalent doped metals with up to 50% trivalent, and show that low doping levels have worse results. The reference of Ma teaches against pure metal, and essentially the entire teaching of Ma is towards heavily doped metals. Col. 2, lines 1-3 states that doping a high-k dielectric with heavy amounts of another material to prevent "the formation of an interfacial SiO_2 layer" (col. 1 lines 45-47) by the addition of a "trivalent metal" at around 50%. Col. 2, lines 58-62 states that it "would be advantageous if improved high-k dielectric materials could be formed by simply doping ... additional elements" into metal oxides. Ma does not teach the use of pure metals, and metal purity is never mentioned in the cited reference.

Park is incorrectly stated by the Examiner to show that sputtering and evaporation are art recognized equivalents. Applicant submits that the present application teaches that sputtering is NOT equivalent to evaporation, and may cause a rough surface and crystal damage (see figure 2b and page 3, lines 17-23, page 7, line 22). This damage increases the leakage current through the gate oxide by a factor of ten times for each 0.1 nm increase in roughness (see page 3, line 1).

Yano is incorrectly stated by the Examiner to deposition of a pure metal, the oxidation of metal, and that smooth metal oxide surfaces are known. Yano teaches the deposition of an oxide from a metal alloy having 75% rare earth metal (col. 8, line 33) in a vacuum chamber with an oxidizing gas (col. 8, line 57) to form an epitaxial oxide layer. Yano does not suggest a pure metal, and does not teach an amorphous dielectric since "epitaxial" is by definition not amorphous. Yano teaches against amorphous materials, against pure metals, and against direct contact of dielectric to semiconductor material.

In conclusion, Applicant respectfully submits that the suggested combination of Ma with Park and Yano fails to describe or suggest at least the claimed feature of "...evaporation depositing a substantially amorphous and 0.99999 pure single element metal layer directly contacting a single crystal semiconductor portion of the body region using electron beam evaporation at a temperature between 150 to 200 °C...". The combination of cited references do

not suggest pure metal, and Applicant requests reconsideration of the rejection.

CONCLUSION

The applicant respectfully submits that all of the pending claims are in condition for allowance, and such action is earnestly solicited. The Examiner is invited to telephone the below-signed attorney at (612) 349-9587 to discuss any questions which may remain with respect to the present application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

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Date 21 July '08 By _____
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CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being filed using the USPTO's electronic filing system EFS-Web, and is addressed to: Mail Stop AF, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 21st day of July 2008.

Name _____ Signature _____